MARKED-UP COPY of subspec. #144

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Honorable Commissioner of Patents and Trademarks
Washington DC 20231

Reference the Application of Mitja Hinderks:

Serial No	**08 / 477 704**
Filed	June 7 1995
Group Art Unit	3747
Examiner	N Kamen
New Title	RECIPROCATING ELEMENTS AND ASSOCIATED FLUID FLOWS

February 7 2002

SUPPLEMENTAL AMENDMENT

Dear Sir / Madam:

It is requested that the attached Supplemental Amendment be entered in the above case, to simplify the title, to rectify errors in the text and drawings, to remove from the disclosure subject matter not linked to the claims, and to eliminate discussion peripheral to the disclosure.

This package contains the following:

1 A numbered set of amendments to the original text of the application attached hereto;

2 An original specification marked to indicate where the amendments are entered, and numbered to refer to the individual amendments above;

3 A clean copy of the specification taking into consideration the foregoing set of amendments;

4 A set in drawings marked in red to indicate renumbering of drawings, cancellation of drawings and minor corrections to the drawings. Three new figures 146, 147 and 148 have been inserted into the clean copy of the drawings, for purpose of explanation only and do not constitute new matter;

5 A revised copy of the drawings in accordance with the amendments marked in red. Please note that this revised copy is informally prepared; formal drawings will be forwarded later.

NOTE TO THE EXAMINER

The above amendments are virtually identical to those reviewed by the examiner in a parallel case, application 08 / 441 117 filed May15 1995, subsequently lapsed. Where there are differences to those amendments here, they are underlined for easy reference.

continued

CONFIRMATION OF SUBJECT MATTER

This is to confirm that the new versions of the text and drawings in the above application that are submitted herewith contain no new subject matter.

The changes to the old text and drawings that are incorporated in the new documents are limited to the following;

a The deletion of all subject matter that does not in some way relate to the present claims;

b The arrangement of blocks of disclosure in different sequence;

c The correction of errors of typography, spelling and numbering;

d The addition in the drawings of missing numerals and letters;

e Clarification where the disclosure was earlier unclear, ambiguous or confusing.

If it is felt that any of the above changes are inappropriate, please let me know as soon as possible so that any needed adjustments can be made.

Please debit my patent office deposit account number ***501 334*** *if any fees should be due.*

Respectfully submitted,

Mitja Victor Hinderks.

Sole inventor, applicant and power-of-attorney of record.

AMENDMENTS

to US patent application no 08 / 447 704 filed June & 1995:

Item # Amendment

General:

A Change the title of the invention to: "RECIPROCATING ELEMENTS AND ASSOCIATED FLUID FLOWS".

B Cancel any previous amendments to the text and diagrams.

C The applicant suggests that, throughout the text, "compression/ratio" be written as "compression ratio".

D In the schedule of itemized amendments below, material in square brackets is for note to the examiner, and is not part of the amendment(s).

Specific:

1 Begin the text from the first line of p 93 of the original, moving the preceding portion of text to the end of the disclosure, that is, removing pages 1 to 92 as then reinstating them as effective pages 227 to 318.

2 Delete Notes 1 through 8.

3 Delete Table 1. Incorporate the material of Table 2 in the main text on p 171, after the end of the first paragraph.

4 Amend the figures as follows, and make the corresponding changes to references to the Figures in the text:

Renumber Fig 1 as Fig 149.
Renumber Fig 2 as Fig 150.
Renumber Fig 3 as Fig 151.
Renumber Fig 4 as Fig 152.
Renumber Fig 5 as Fig 153.
Renumber Fig 6 as Fig 154.
Renumber Fig 7 as Fig 155.
Renumber Fig 8 as Fig 156.
Renumber Fig 9 as Fig 157.
Renumber Fig 10 as Fig 158.

Renumber Fig 11 as Fig 159.
Renumber Fig 12 as Fig 160.
Renumber Fig 13 as Fig 161.
Renumber Fig 14 as Fig 162.
Renumber Fig 15 as Fig 163.
Renumber Fig 16 as Fig 164.
Renumber Fig 17 as Fig 165.
Renumber Fig 18 as Fig 166.
Renumber Fig 19 as Fig 167.
Renumber Fig 20 as Fig 168.

Renumber Fig 21 as Fig 169.
Renumber Fig 22 as Fig 170.
Renumber Fig 23 as Fig 171.
Renumber Fig 24 as Fig 172.
Renumber Fig 25 as Fig 173.
Renumber Fig 26 as Fig 174.
Renumber Fig 27 as Fig 175.
Renumber Fig 28 as Fig 176.
Renumber Fig 29 as Fig 177.
Renumber Fig 30 as Fig 178.

Renumber Fig 31 as Fig 179.
Renumber Fig 32 as Fig 180.
Renumber Fig 33 as Fig 181.
Renumber Fig 34 as Fig 182.
Renumber Fig 35 as Fig 183.
Renumber Fig 36 as Fig 184.
Renumber Fig 37 as Fig 185.
Renumber Fig 38 as Fig 186.
Renumber Fig 39 as Fig 187.
Renumber Fig 40 as Fig 188.

Renumber Fig 41 as Fig 189.
Renumber Fig 42 as Fig 190.
Renumber Fig 43 as Fig 191.
Renumber Fig 44 as Fig 192.
Renumber Fig 45 as Fig 193.
Renumber Fig 46 as Fig 194.
Renumber Fig 47 as Fig 195.
Renumber Fig 48 as Fig 196.
Renumber Fig 49 as Fig 197.
Renumber Fig 50 as Fig 198.

Renumber Fig 51 as Fig 199.
Renumber Fig 52 as Fig 200.
Renumber Fig 53 as Fig 201.
Renumber Fig 54 as Fig 202.
Renumber Fig 55 as Fig 203.
Renumber Fig 56 as Fig 204.
Renumber Fig 57 as Fig 205.
Renumber Fig 58 as Fig 206.
Renumber Fig 59 as Fig 207.
Renumber Fig 60 as Fig 208.

Renumber Fig 61 as Fig 209.
Renumber Fig 62 as Fig 210.
Renumber Fig 63 as Fig 211.
Renumber Fig 64 as Fig 212.
Renumber Fig 65 as Fig 213.
Renumber Fig 66 as Fig 214.
Renumber Fig 67 as Fig 215.
Renumber Fig 68 as Fig 216.
Renumber Fig 69 as Fig 217.
Renumber Fig 70 as Fig 218.

Renumber Fig 71 as Fig 219.
Renumber Fig 72 as Fig 220.
Renumber Fig 73 as Fig 229.
Renumber Fig 74 as Fig 230.
Renumber Fig 75 as Fig 231.
Renumber Fig 76 as Fig 232.
Renumber Fig 77 as Fig 233.
Renumber Fig 78 as Fig 234.
Renumber Fig 79 as Fig 235.
Renumber Fig 80 as Fig 236.

Renumber Fig 81 as Fig 237.
Renumber Fig 82 as Fig 238.
Renumber Fig 83 as Fig 239.
Renumber Fig 84 as Fig 240.
Renumber Fig 85 as Fig 241.
Renumber Fig 86 as Fig 242.
Renumber Fig 87 as Fig 243.
Renumber Fig 88 as Fig 244.
Renumber Fig 89 as Fig 245.
Renumber Fig 90 as Fig 246.

Renumber Fig 91 as Fig 247.
Renumber Fig 92 as Fig 248.
Renumber Fig 93 as Fig 249.
Renumber Fig 94 as Fig 250.
Delete Fig 95.
Delete Fig 96.
Renumber Fig 97 as Fig 252.
Renumber Fig 98 as Fig 253.
Renumber Fig 99 as Fig 254.
Renumber Fig 99a as Fig 255.
Renumber Fig 100 as Fig 271.

Renumber Fig 101 as Fig 272.
Renumber Fig 102 as Fig 273.
Renumber Fig 103 as Fig 274.
Renumber Fig 104 as Fig 275.
Renumber Fig 105 as Fig 276.
Renumber Fig 106 as Fig 277.

Delete Figs 107 through 124.

Renumber Fig 125 as Fig 221.
Renumber Fig 126 as Fig 222.
Renumber Fig 127 as Fig 223.
Renumber Fig 128 as Fig 224.
Renumber Fig 129 as Fig 225.
Renumber Fig 129a as Fig 226.
Renumber Fig 130 as Fig 227.

Renumber Fig 131 as Fig 228.
Renumber Fig 132 as Fig 1.
Renumber Fig 133 as Fig 2.
Renumber Fig 134 as Fig 3.

Renumber Fig 135 as Fig 4.
Renumber Fig 136 as Fig 5.
Renumber Fig 137 as Fig 6.
Renumber Fig 138 as Fig 7.
Renumber Fig 139 as Fig 8.

Renumber Fig 140 as Fig 9.
Renumber Fig 141 as Fig 10.
Renumber Fig 142 as Fig 11.
Renumber Fig 143 as Fig 12.
Renumber Fig 144 as Fig 251.

Delete Figs 145 through 154.

Renumber Fig 155 as Fig 278.
Renumber Fig 156 as Fig 279.
Renumber Fig 157 as Fig 280.

Delete Figs 158 through 165.

Renumber Fig 166 as Fig 256.

Renumber Fig 167 as Fig 257.
Renumber Fig 168 as Fig 258.
Renumber Fig 169 as Fig 259.
Renumber Fig 170 as Fig 260.

Renumber Fig 171 as Fig 261.
Renumber Fig 172 as Fig 262.
Renumber Fig 173 as Fig 263.
Renumber Fig 174 as Fig 264.
Renumber Fig 175 as Fig 265.
Renumber Fig 175a as Fig 266.
Renumber Fig 176 as Fig 267.
Renumber Fig 177 as Fig 268.
Renumber Fig 178 as Fig 269.
Renumber Fig 179 as Fig 270.
Renumber Fig 180 as Fig 13.

Delete Fig 181.
Delete Fig 182.
Renumber Fig 183 as Fig 14.
Renumber Fig 184 as Fig 15.
Renumber Fig 185 as Fig 16.
Delete Fig 186.
Delete Fig 187.
Renumber Fig 188 as Fig 17.
Renumber Fig 189 as Fig 20.
Renumber Fig 190 as Fig 23.

Renumber Fig 191 as Fig 24.
Renumber Fig 192 as Fig 25.
Renumber Fig 193 as Fig 26.
Renumber Fig 194 as Fig 27.
Renumber Fig 195 as Fig 28.

Renumber Fig 196 as Fig 29.
Renumber Fig 197 as Fig 30.
Renumber Fig 198 as Fig 31.
Renumber Fig 199 as Fig 32.
Renumber Fig 200 as Fig 35.

Renumber Fig 201 as Fig 36.
Renumber Fig 202 as Fig 37.
Renumber Fig 203 as Fig 38.
Renumber Fig 204 as Fig 39.
Renumber Fig 205 as Fig 40.
Renumber Fig 206 as Fig 41.
Renumber Fig 207 as Fig 42.
Renumber Fig 208 as Fig 43.
Renumber Fig 209 as Fig 44.
Renumber Fig 210 as Fig 45.

Renumber Fig 211 as Fig 46.
Renumber Fig 212(b) as Fig 47.
Renumber Fig 213 as Fig 48.
Renumber Fig 214 as Fig 49.
Renumber Fig 215 as Fig 50.
Renumber Fig 216 as Fig 51.
Renumber Fig 217 as Fig 52.
Renumber Fig 218 (erroneously labelled 219) as Fig 53.
Renumber Fig 219 as Fig 54.
Renumber Fig 220 as Fig 55.

Renumber Fig 221 as Fig 56.
Renumber Fig 222 as Fig 57.
Renumber Fig 223 as Fig 58.
Renumber Fig 224 as Fig 59.
Renumber Fig 225 as Fig 60.
Renumber Fig 226a as Fig 61.
Renumber Fig 226b as Fig 62.
Renumber Fig 227 as Fig 63.
Renumber Fig 228 as Fig 64.

Delete Figs 229 through 231.

Renumber Fig 232 as Fig 65.
Renumber Fig 233 as Fig 66.
Renumber Fig 234 as Fig 67.
Delete Fig 235 (erroneously labelled 237).
Renumber Fig 236 as Fig 68.
Renumber Fig 237 as Fig 69.
Renumber Fig 238 as Fig 70.
Renumber Fig 239 as Fig 71.
Renumber Fig 240 as Fig 18.

Renumber Fig 241 as Fig 19.
Renumber Fig 242 as Fig 21.
Renumber Fig 243 as Fig 22.
Renumber Fig 244 as Fig 33.
Renumber Fig 245 (erroneously numbered 225) as Fig 34.

Renumber Fig 246 as Fig 72.
Renumber Fig 247 as Fig 73.
Renumber Fig 248 as Fig 74.
Delete Fig 249.
Delete Fig 250.

Renumber Fig 251 as Fig 75.
Renumber Fig 252 as Fig 76.
Renumber Fig 253 as Fig 77.
Renumber Fig 254 as Fig 78.
Renumber Fig 255 as Fig 79.
Renumber Fig 256 as Fig 80.

Delete Figs 257 through 344.

Renumber Fig 345 as Fig 81.
Renumber Fig 346 as Fig 82.
Renumber Fig 347 as Fig 83.
Renumber Fig 348 as Fig 84.
Renumber Fig 349 as Fig 85.
Renumber Fig 350 as Fig 86.

Renumber Fig 351 as Fig 88.
Renumber Fig 352 as Fig 87.
Renumber Fig 353 as Fig 89.
Renumber Fig 354 as Fig 90.
Renumber Fig 355 as Fig 91.
Renumber Fig 356 as Fig 92.
Renumber Fig 357 as Fig 93.
Renumber Fig 358 as Fig 94.
Renumber Fig 359 as Fig 95.
Renumber Fig 360 as Fig 96.

Renumber Fig 361 as Fig 97.
Delete Fig 362.
Delete Fig 363.
Renumber Fig 364 as Fig 98.
Renumber Fig 365 as Fig 99.
Renumber Fig 366 as Fig 100.
Renumber Fig 367 as Fig 101.
Renumber Fig 368 as Fig 102.
Delete Fig 369.
Delete Fig 370.

Renumber Fig 371 as Fig 103.
Renumber Fig 372 as Fig 104.
Renumber Fig 372 as Fig 105.
Renumber Fig 374 as Fig 106.
Renumber Fig 375 as Fig 107.
Renumber Fig 376 as Fig 108.

Delete Figs 377 through 389.

Renumber Fig 390 as Fig 109.

Renumber Fig 391 as Fig 110.
Renumber Fig 392 as Fig 111.
Renumber Fig 393 as Fig 112.
Renumber Fig 394 as Fig 113.
Renumber Fig 395 as Fig 114.
Renumber Fig 396 as Fig 115.
Renumber Fig 397 as Fig 116.
Renumber Fig 398 as Fig 117.
Renumber Fig 399 as Fig 118.
Renumber Fig 400(a) as Fig 119.
Renumber Fig 400(b) as Fig 120.

Renumber Fig 401 as Fig 121.
Renumber Fig 402 as Fig 122.
Renumber Fig 403 as Fig 123.
Renumber Fig 404 as Fig 124.
Renumber Fig 405 as Fig 125.
Renumber Fig 406 as Fig 126.
Renumber Fig 406a as Fig 127.
Renumber Fig 407 as Fig 128.
Renumber Fig 408 as Fig 129.
Renumber Fig 409 as Fig 130.
Renumber Fig 410 as Fig 131.

Renumber Fig 411 as Fig 132.
Renumber Fig 412 as Fig 133.
Delete Fig 413.
Renumber Fig 414 as Fig 134.
Renumber Fig 415 as Fig 135.
Renumber Fig 416 as Fig 136.
Renumber Fig 417 as Fig 137.
Renumber Fig 418 as Fig 138.
Renumber Fig 419 as Fig 139.
Renumber Fig 420 as Fig 140.

Renumber Fig 421 as Fig 141.
Renumber Fig 422 as Fig 142.
Renumber Fig 423 as Fig 143.
Renumber Fig 424 as Fig 144.
Renumber Fig 425 as Fig 145.

Delete Figs 426 through 470.

5 Before the beginning of the text - now starting on p 93 - insert the following:

TECHNICAL FIELD: The disclosure relates to internal combustion engines, pumps, exhaust emission control devices, as well as their components and ancillary equipment.

BACKGROUND:

Many have considered it desirable to build engines running at higher temperatures. Efficiency would improve, since it is dependent on the difference in temperature between ambient air (which is constant) and that at combustion. The resulting hotter exhaust gases will generally be easier to cleanse. If the cooling system can be eliminated, so can its cost, mass, bulk and unreliability. Uncooled engines can be thermally, acoustically and vibrationally insulated to virtually any degree, making them more environmentally and

socially acceptable. Of the calorific value of the fuel, a greater amount will be spent on pushing a piston, but nearly all the remainder will now be in the hot exhaust gas, where it is recoverable. With the new engines, temperature equilibria would be so high that the main piston and cylinder components would likely have to be of ceramic material.

To the knowledge of the applicant, uncooled engines are not in production today. Manufacturers and researchers tried to build uncooled engines in the 1980's and earlier. Publications indicate the work nearly all involved substituting ceramic materials for metals in key combustion chamber components. For example, ceramic caps were placed on metal pistons; ceramic liners placed in metal engine blocks; a zirconia poppet valve was substituted for an identically shaped metal valve. The work was not very successful for a number of reasons, including problems with differential thermal expansion of ceramic and metal components abutting each other. Engine designs were essentially unchanged.

Early internal combustion (IC) engine designers like Gottfried Daimler and Rudolf Diesel adapted the mid-18th century metal piston-and-cylinder technology developed for steam engines. Today's metal IC engines reflect three constraints; the materials characteristics of metals; the need for cooling and therefore the engine block, etc; and commercial practice determining the most viable ways of manufacturing and assembling metal components.

The applicant felt that any viable commercial embodiment of the uncooled ceramic engine would look very different from today's units, because all the old constraints were no longer relevant, and new constraints would apply. This disclosure is the result of his attempt to adapt and modify the traditional design of the piston and cylinder engine, so that new embodiments could be viably built uncooled and out of ceramic material. Because exhaust emissions control is so important today, new arrangements for cleansing high temperature exhaust gases were devised, and are disclosed herein.

In today's typical engine, roughly one third of the calorific value of the burnt fuel is put to work driving the piston, one third is dissipated via the cooling system and general radiation by the engine components and one third is carried away by the exhaust gases. The latest large diesels for trucks and marine applications have efficiencies in the 40 % range, but the average for all engines now operating is close to 30 %. Current large engines, as used in ships and electricity generating stations, often have some form of compounding, which entails using a device (say a turbine) to derive further work from the hot exhaust gases.

In uncooled engines, the combustion process takes place at higher temperatures, leading to efficiency increases of anywhere between 0 and 20 %, dependant on design and construction details. A reasonable projection could be 10 %, enough to make to make a substantial difference to the oil needs and political situation of a country such as the USA. In compounded uncooled engines greater efficiencies can be expected, since the exhaust energy conversion devices have a greater portion of the fuel's calorific value to work with - somewhere between 50 and 60 % could be in the hot exhaust gas. Turbines or steam engines may be used to extract work from the hot gas; optionally the gas heat can be converted into electrical energy. At their present stage of development, heat to electrical energy devices have very approximately 25 % efficiency.

The uncooled engine preferably uses the internal combustion cycles, although the principles of the invention may also be applied to, for example, engines operating on the Rankine or Stirling cycles. It is intended to construct such an engine to operate continuously in an uncooled state, so that it might be used to power, for example, generating plant, light cars and trucks, heavy goods vehicles, locomotives, marine vessels including supertankers, etc. Heat can be extracted from the area of, or downstream of, an exhaust gas reactor to provide further work. The invention may be used in association with a means of converting the flow of exhaust gas into mechanical energy.

CLARIFICATIONS

[Adapted from p 103, ln 17 through end p 104:]

By "uncooled" is meant engines having restricted or no cooling, compared to general current production engine practice and includes engines with partial cooling.

The features described herein illustrate by way of example the many ways uncooled engines and exhaust gas reaction volumes may be constructed. Any type of piston or valve may be used in an uncooled engine and the engine portions may be assembled in any manner.

The features of the uncooled engine have been described mainly in relation to internal combustion engines, although they are suited to and may be applied to any type of combustion engine, including for example Stirling and steam engines. The features relating to heat exchangers may be embodied in any type of engine, including conventionally cooled engines.

Where appropriate, features described herein may be applied to pumps. The word "engine" is used in its widest possible meaning and, where appropriate, is meant to include pump and / or compressor.

It is emphasized that the various features and embodiments of the invention may be used in any appropriate combination or arrangement. Where diagrams or embodiments are described, these are always by way of example and / or illustration of the principles of the invention. Further, it is considered that any of the separate features of this complete disclosure comprise independent inventions.

In the following text and recital of claims, "filamentary material" shall be defined as portions of interconnected material which allow the passage of gases therethrough and induce turbulence and mixing by changing the directions of travel of portions of gas relative to one another, the inter-connection being integral, continuous, intermeshing, interfitting or abutting, this definition applying to the material within a gas processing volume as a whole as well as to particular portions of it.

By "ceramic" is meant baked, fired or pressed non-metallic material that is generally mineral, ie ceramic in the widest sense, encompassing materials such as glass, glass ceramic, shrunken or recrystallized glass or ceramic, etc., and refers to the base or matrix material, irrespective of whether other materials are present as additives or reinforcement.

[Not previously clarified in text:]

By "elastomeric", "compressible", "elastic"," variable volume", "flexible", "bending" and all other expressions indicating dimensional change is meant a measurable change that is designed for, not a relatively small dimensional change caused by temperature variation or the imposition of loads on solid or structural bodies.

By "ring valve" is meant an movable ring-shaped element normally approximately flush with a surrounding and a core surface. When the valve is actuated, it projects from any planes of the surrounding and core surface, causing fluid to flow past both the outer and the inner circumferences of the ring.

In the following text, abbreviations are used, including: rpm and rps for "revolutions per minute" and "revolutions per second" respectively, BDC / TDC for "bottom dead center / top dead center", IC for "internal combustion".

SUMMARY: The invention is summarized in the claims.

BRIEF DESCRIPTION OF THE DRAWINGS:

Figures 1 to 3	show schematically a configuration and details of an uncooled engine.
Figure 4	shows the deployment of heat exchange means within a reactor.
Figure 5	illustrates the interconnection of two engines.

Figures 6 to 8	illustrate linkage of crankshaft sections.
Figure 9	illustrates schematically a configuration of composite engine.
Figures 10 and 11	show diagrammatically how two engine cycles may be operative in one engine.
Figure 12	illustrates schematically a heat exchanger associated with a reactor and a turbine engine assembly.
Figure 13	shows schematically heat exchangers associated with turbine assemblies.
Figures 14 to 17	show further configurations and details of uncooled engines.
Figures 18 and 19	show pull-wire valve actuation methods.
Figures 20 to 22	show schematic layouts of tensile link engines.
Figures 23 to 32	show schematic layouts of multi-cylinder tensile link engines.
Figures 33 and 34	show schematically multiple crankshaft tensile link "ring" engines.
Figures 35 to 38	illustrate possible varying lengths of tensile links.
Figure 39	illustrates two- and four-stroke operation.
Figure 40	illustrates an offset crankshaft axis.
Figures 41 to 44	show details of crankshaft construction.
Figures 45 to 48	show details of a tensile link embodiment.
Figures 49 to 58	show details of alternative tensile link embodiments.
Figures 59 and 60	show an interface between tensile link and cylinder head.
Figures 61 to 64	show arrangements of ring valves.
Figures 65 to 67	show methods of fluid delivery.
Figures 68 to 70	show a piston and cylinder assembly.
Figure 71	shows a method of reducing piston blow-by.
Figures 72 to 74	show bearing construction details.
Figures 75 and 76	show schematically engines having twin separate exhaust systems.
Figures 77 to 80	show details of a twin exhaust system engine.
Figures 81 to 83	show schematically a variable lift combined crank and cam-shaft.
Figures 84 to 86	show methods of varying bearing fluid pressure.
Figures 87 to 89	illustrate the basic features of toroidal combustion chambers.
Figures 90 to 95	show schematic layouts of working chambers and reciprocating components.
Figures 96 and 97	show ways of compensating for differential movement of twin crankshafts.
Figures 98 to 102	illustrate the principles of imparting different motions to a reciprocating component.
Figures 103 to 108	show devices for converting multiple motion to rotating motion.
Figures 109 to 112	illustrate the principles of sinusoidal toroidal combustion chambers.
Figure 113	illustrates a two-stage toroidal combustion chamber engine.
Figures 114 and 115	show part profiles of sinusoidal toroidal combustion chambers.
Figures 116 to 118	show engines with a differential function.
Figures 119 to 124	show details of sinusoidal toroidal engines.
Figure 125	shows schematically multiple pairs of toroidal combustion chambers.
Figures 126 to 128	show methods for varying ratio of one motion to another.
Figures 129 to 132	show alternative gas flow arrangements.
Figure 133	shows a combustion chamber profile.
Figure 134	shows schematically an engine with one toroidal and one conventional chamber.
Figures 135 to 145	show construction details of modular and other engines.
Figures 146 to 148	show forms of gas treatment volumes.
Figure 149	is a diagrammatic plan view of an exhaust gas reactor assembly.
Figure 150	is a cross-sectional view taken on the line 2 - 2 of Fig. 149.
Figure 151	is a cross section view taken on the line 3 - 3 of Fig. 149
Figure 152	is a cross section view, similar to Fig. 151, but showing a modified construction.
Figure 153	is a cross sectional view, also similar to Fig. 151, but showing a further modified construction.
Figures 154 to 159	show diagrammatically in vertical cross-section various arrangements of intermembers.
Figures 160 to 162	show in cross-section various fixing details.
Figures 163 and 164	show diagrammatically in sectional plan view two examples wherein reaction volumes project into space normally occupied by the engine.
Figures 165 and 166	show arrangements of the axes of exhaust port openings.

Figures 167 to 172	describe means of directing exhaust gas flow.
Figures 173 to 176	describe means of imparting swirl to exhaust gases.
Figure 177	illustrates a preferred embodiment.
Figures 178 and 179	describe honeycomb and wool filamentary construction.
Figures 180 and 181	describe expanded metal or metal mesh construction.
Figure 182	describes woven and knitted wire.
Figures 183 to 185	describe spiral wire construction.
Figures 186 to 194	describe looped wire construction.
Figures 195 to 199	describe wire strand and associated features.
Figures 200 to 208	describe various slab-like sheet configurations.
Figures 209 to 213	describe sheet used in three dimensional forms.
Figures 214 to 220	describe details of fixing filamentary matter to reactor housing.
Figures 221 to 228	illustrate pellet-like filamentary material.
Figures 229 and 230	show an embodiment of exhaust gas reservoir.
Figures 231 and 232	show diagrammatically valve, gas routing and component arrangements.
Figures 233 to 237	show an embodiment of butterfly valve in the situation of Fig. 231.
Figures 238 and 239	show an embodiment of butterfly valve in the situation of Fig. 232.
Figures 240 and 241	show an embodiment of ball valve in the situation of Fig. 232.
Figures 242 to 244	describe examples of valve actuating means.
Figures 245 to 250	describe means of controlling exhaust gas recirculation (EGR) and air supply.
Figure 251	illustrates an embodiment of fluid reservoir of variable volume.
Figures 252 to 255	show embodiments of composite injectors supplying multiple substances.
Figures 256 and 257	show schematically injectors capable of motion in three dimensions.
Figures 258 to 270	show embodiments of movable injectors and/or their locations.
Figure 271	illustrates the principle of reduced resistance to gas flow adjacent reactor housing.
Figures 272 to 277	describe reactor wall construction embodying depressions or projections.
Figures 278 to 280	show a variable diameter inlet throat.

PREFERRED EMBODIMENTS

6	p 93	ln 1	Delete from "Energy Reclamation . . . " top of p 93 to end of para p 95 ". . . such as the U.S.A." [The two last sentences of p 93 and the second and third sentences of p 94 are included in adapted form in the background description above.]
7	p 96	ln 1	Insert comma after 'embodiment'.
8		ln 5	Delete "As has been mentioned in a previous section," capitalize C in 'ceramics'.
9		ln 9	Add, after '. . . connecting rods, etc.': "The uncooled engine may have a housing or casing made of insulating material, further limiting heat loss through radiation." [Refers to embodiments of Figs 189, 242, 408 through 411, 416, 419, 420, in original numbering.] Delete "However, in a more practical", make new paragraph and replace with: "In a basic".
10		ln 12	Add "a" after 'example', comma after 'engine'.
11		ln 14	Replace "carburetor" with "fuel delivery device".
12		ln 16	Delete comma after 'port', substitute period, capitalize 'A', change 'of which' to: "at the port".
13		ln 18	Delete sentence: " Figure 134 shows . . . . by passage 413, in cylinder block 401."
14		ln 21	Add commas after 'containing' and "floor 416".

15		ln 22	Add "the" after 'forcing'.
16		ln 23	Delete "bounded", substitute "bonded".
17		ln 27	Delete "is of material preferably", substitute: "can be of".
18		ln 28	Delete end clause: ",to ensure . . . . wear coefficients".
19	p 97	ln 1	Insert "(not shown)" after 'piston'; delete "gives", substitute "can give".
20		ln 12	Delete sentence: "Ceramics is . . . . described elsewhere."
21		ln 18	Delete "in other sections", substitute: "elsewhere herein"; change "their" to "the", insert"of substances" before 'at'.
22		ln 19	Insert comma after 'pressure'.
23		ln 22	Insert comma after 'head'.
24	p 98	ln 1	Change "A" to "An exhaust gas", insert "or within" after 'an'.
25		ln 2	Insert "the" after 'to'.
26		ln 3	Change "engine" to "engines", delete comma before 'heat'.
27		ln 4	Add comma and "either" after 'cycle', delete "either" at start of ln 5.
28		ln 8	Add comma after '421'.
29		ln 14	Delete period, add comma and "as described later" after 'material'.
30		ln 16	Delete "behind ", substitute: "downstream of ".
31		ln 22	Delete "it", substitute: "then the latter ".
32	p 99	ln 3	Insert commas after 'fluid' and 'air'.
33		ln 5	Place 'such as acceleration' within brackets.
34		ln 6	Delete "(see other sections)".
35		ln 9	Change "induction stroke" to "operation".
36		ln 15	Insert commas after 'by a' and 'say'.
37		ln 16	Insert comma after 'clutch", change "eliminate" to "reduce", delete "torsional".
38		ln 24	Insert three commas after 'Figure 139', 'and', 'outline".
39	p 100	ln 1	Insert "is" before 'attached', a comma after '452', change "in" to "and is".
40		ln 2	Change "453" to "453a", insert period after 'flanges', change "and the piston separating" to: "The piston separates".
41		ln 10	Change "as" to "in an".

42		ln 12	Insert comma after '461'.
43		ln 21	Insert period after "143". Continue: "An IC engine 467 has . . ."
44		ln 23	Insert comma after '473'.
45		ln 25	Change "expansion" to "heating".
46		ln 26	Delete "of the invention".
47	p 101	ln 2	Insert comma after '900'.
48		ln 10	Insert "reciprocating" before 'engine'.
49		ln 11	Change "vehicle" to "vehicles".
50		ln 13	Delete from "Figure 181 shows . . ." to end of para at ". . . portion of engine".
51	p 102	ln 3	Insert comma after 'reason'.
52		ln 5	Insert commas after 'shows' and 'example'.
53		ln 6	Insert comma after '930'.
54		ln 9	Insert "gas flows" between 'both' and 'shown'.
55		ln 10	Insert "(fluid flows shown solid) after 'cycle'.
56		ln 11	Insert comma after 'assembly'.
57		ln 22	Insert comma after '947'.
58		ln 24	Delete from "In an embodiment . . ." to ". . . spring clips 958" on ln 1, p 103.
59	p 103	ln 7	Insert comma after 'example'.
60		ln 8	Change "there is shown" to "shows".
61		ln 12	Insert comma after 'ambient', delete ", as when the engine is cold".
62		ln 17	Delete from "The above features . . ." to ". . . additives or reinforcement" at the end of page 104. [Note: Most of this material has been incorporated earlier, in the section headed CLARIFICATION.]
63	p 105	ln 1	Delete from title "CERAMIC ADIABATIC . . ." to end of ln 10 ". . . jet engine cycles".
64		ln 20	Insert commas after 'eliminated' and '241'.
65		ln 23	Insert comma after 'illustrated)'.
66	p 106	ln 1	Change "CAICE" to "engine".
67		ln 2	Insert period after 'Figure 189' (now 20), replace"and" with "It", change "oscillating" to "reciprocating".

68		ln 3	Insert comma after '1004'.
69		ln 4	Change "member" to "members".
70		ln 9	Insert comma after '1008'.
71		ln 14	Insert "and / or" after 'lubrication'.
72		ln 16	Insert ", as described later" after 'material', delete "This is further described in Subsection Three. In the case of air bearings", capitalize 'The'.
73		ln 18	Change "its" to "any".
74		ln 19	Insert comma after 'induction'.
75		ln 20	Change semi-colon to period, capitalize 'In', insert comma after 'engines'.
76		ln 23	Insert comma after '1276'.
77		ln 24	Insert commas after '1277' and 'shown)', insert "fuel" before 'injection'.
78		ln 25	Change "exit" to "exits", add sentence after '1290.' "Insulation 1010 extends around the engine of Figure 20 and is shown around the crankcases and engine of Figure 21."
79		ln 26	Add after 'example' "of either a two- or four-stoke engine,".
80		ln 27	Insert "and / or" between 'roller' and 'wheels'.
81	p 107	ln 2	Insert comma, "as is" after 'configuration', insert comma after '190', "and" after '191'.
82		ln 3	Insert comma after '192' (now 25).
83		ln 4	Insert comma after 'crankshafts'.
84		ln 8	Insert comma after 'configuration'.
85		ln 11	Insert comma and "a" after '196'.
86		ln 12	Insert comma after 'shown'.
87		ln 14	Delete 2nd "or", insert comma after 'required'.
88		ln 16	Insert commas after 'Alternatively' and 'employed'.
89		ln 17	Transpose Figure numbers.
90		ln 20	Insert comma after 'rods'.
91		ln 24	Insert comma after 'engine'.
92		ln 27	Insert before 'four': "three rings, each of".
93	p 108	ln 1	Change IC to "reciprocating".
94		ln 5	Delete "2. General Design Analysis".

95		ln 6	Change "The generalized" to "A general" and "an engine" to "engines".
96		ln 7	Insert "ratios" after 'weight' and after 'bulk', change "efficiency" to "efficiencies", delete "In the present case" and capitalize 'This'.
97		ln 8	Insert "1" after 'means:'.
98		ln 9	Change "IC" to" reciprocating", insert "2" after 'configuration,'.
99		ln 10	Insert after 'masses,': "and therefore the reduction of size and mass of key structural components," and replace "and" with "3".
100		ln 11	Insert after 'system' : (thereby increasing temperatures during combustion and therefore efficiency).
101		ln 12	Replace "It is obvious that the CAICE configuration concept" with: "The above piston and cylinder configuration".
102		ln 15	Delete "only", change "not" to "rather than".
103		ln 16	Delete: ",and so necessitates an arrangement of IC parts".
104		ln 17	Insert commas after 'piston' and 'crank'.
105		ln 23	Insert comma after 'expansion".
106	p 109	ln 5	Insert comma after 'insulated'.
107		ln 8	Insert comma after 'embodiment', change "low" to "hot".
108		ln 12	Insert commas after 'gradients' and 'stresses'.
109		ln 14	Start new paragraph with "It is generally . . ."
110		ln 15	Change "proportional to" to "in rough proportion to the difference between".
111		ln 16	Change "gradients" to " and combustion temperature,".
112		ln 25	Insert comma after 'that'.
113		ln 27	Insert comma after 'chamber'.
114	p 110	ln 1	Delete "It is now generally accepted that", capitalize 1st 'The'.
115		ln 2	Insert "probably" after 'will', delete "that".
116		ln 10	Delete "in Subsection Three".
117		ln 11	Insert "the" after 'plus'.
118		ln 13	Insert comma after 'purposes', delete "all".
119		ln 18	Star new para at "As noted . . ."
120		ln 19	Insert "among" after 'earlier,'.

121		ln 20	Insert commas after both "losses".
122		ln 29	Change "temperature resistance" to "structural performance", insert "at a given temperature" after 'materials'.
123	p 111	ln 1	Delete two sentences, from "With increase . . ." to ". . . inhibits disassociation" on ln 4.
124		ln 6	Insert comma after 'Additionally'.
125		ln 9	Change "engine" to "engines".
126		ln 16	Insert comma after 'actuation'.
127		ln 18	Insert comma after 'speed'.
128		ln 19	Delete "(see Note 1)".
129		ln 20	Change "twofold" to "four fold".
130		ln 22	Insert comma after 'words', change "present" to "new".
131		ln 24	Change "and" to "and / or".
132		ln 27	Insert comma after 'losses'.
133	p 112	ln 3	Insert comma after 'that'.
134		ln 4	Insert comma after 'engines'.
135		ln 6	Change comma to period, capitalize 'The', change 'being' to "tend to be".
136		ln 7	Insert commas after 'and' and 'initiated'.
137		ln 11	Insert comma after 'Therefore", insert "is" after 'water'.
138		ln 13	Insert "combustion" before "delay".
139		ln 15	Change "it vaporizes" to "they vaporize".
140		ln 20	Start new para at "In comparison . . ."
141		ln 21	Insert "(in some embodiments)" after' design'.
142		ln 22	Insert ", as described below" after 'ends', delete "(See Section Three)".
143		ln 23	Insert commas after 'raised' and 'engines', change "giving" to "given".
144		ln 27	Change "at least" to "perhaps".
145	p 113	ln 2	Change "250" and "400" to "200" and "300" respectively, insert after 'range.': "Today, most diesels run at far lower than theoretical maximum speeds, the limiting factor being the stresses caused by reciprocating mass. With the new engines this presents virtually no problem, so all diesels could run at similar speeds, closer to theoretical maxima. In large engines, such as for marine applications, speeds could increase from around 18 rps to over 150 rps."

146		ln 3	Insert comma after 'reason', change "camshafts have" to "camshaft movement has".
147		ln 4	Change "inexplicable"to "difficult to understand".
148		ln 12	Change "camshafts are" to "camshaft movement could be".
149		ln 16	Delete heading "3. Constructional details".
150		ln 17	Delete first sentence and part of next, from "The design . . ." to ". . . parameters are" and substitute: "The issue of the tensile link between piston and crank is"
151		ln 20	Insert comma after 'previously', insert after 'crank,' "if the cranks are to rotate synchronously." Delete "as shown diagrammatically in" and substitute: "Diagrammatical".
152		ln 21	Delete "wherein 1100".
153		ln 22	Insert "1100" after 'centers'.
154		ln 24	Insert comma after 'cylinder' and "dotted" before 'line.
155		ln 26	Insert comma after 'that'.
156	p 114	ln 2	Insert comma after 'center'.
157		ln 7	Change 2nd "piston" to "cylinder".
158		ln 9	Insert after 'cylinder' : "(or the tensile system has to be elastomeric)".
159		ln 10	Start new para at "So far . . ."
160		ln 12	Change "angles" to "rotation" and "are" to "is".
161		ln 13	Replace semi-colon with comma and insert "where" before 'tensile'.
162		ln 14	Delete sentence "Two optional . . . . chamber 1109", replace with : "The piston 1102 is shown dotted when it is in the center of the cylinder."
163		ln 17	Insert comma after '180 degrees'.
164		ln 21	Start new para at "The tensile link . . ."
165		ln 23	Delete "a constant", substitute "an equal".
166		ln 24	Replace first comma with semi-colon.
167		ln 26	Insert "are" before 'angled'.
168	p 115	ln 2	Change " the piston could be moving" to "such an arrangement could be used to cause the piston to move".
169		ln 9	Delete "much".
170		ln 10	Insert "base" and "of Figure 20" before and after 'configuration'.
171		ln 12	Replace "in order to . . . at BDC?TDC. By" on ln 14 with : "it is assumed that when the

cranks turn through 90 degrees relative to BDC?TDC, the piston is in the center of the cylinder and the tensile halves have equal slack. Considering one combustion chamber, by".

172		ln 18	Insert "is" after 'slack', delete "It is" and replace with : "In some embodiments, it may be".
173		ln 23	Delete "is not", substitute : "may not be".
174		ln 24	Insert comma after 'TDC'.
175		ln 25	Insert before 'The": "The presence of slack towards the ends of piston travel could it to spend more time there, allowing more time for combustion to develop and / or for fluid transfer to take place."
176		ln 26	delete period and insert comma after 'Figure 205', then add : "say in low power applications where axial loads at the head do not present a problem. (In those applications where the cranks may not rotate synchronously, differential rotation could be absorbed by using final drive devices such as illustrated in Figures 96 and 97.)"
177	p 116	ln 2	Insert comma after 2nd 'speed'.
178		ln 3	Substitute colon for comma.
179		ln 4	Insert comma after 'position'.
180		ln 5	Insert comma after 'compression'.
181		ln 8	Insert comma after 'period'.
182		ln 10	Insert comma after 'However'.
183		ln 11	Insert comma after 'greater', delete "where".
184		ln 14	Insert "ratio" after 'compression'.
185		ln 15	Insert after 'gas' : "(the link to the crank towards which it is travelling has the slack, the link with which it is pulling the other crank is taut)".
186		ln 16	Insert comma after 'climbs'.
187		ln 18	Change "The" to : "One of the".
188		ln 20	Delete two sentences, from "This may be . . ." to ". . . by higher pressure."on ln 22.
189		ln 24	Delete : "(See Note 6)".
190		ln 25	Delete "It is obvious that", substitute : "In some embodiments," and replace "has to" with "should".
191		ln 26	Insert comma after 'speed'.
192	p 117	ln 1	Insert comma after 'designs'.
193		ln 6	Change "before' to "around", insert comma after 'introduced'.

194		ln 7	Delete "before TDC'.
195		ln 13	Insert comma after 'that'.
196		ln 18	Change "The" to "In two stroke engines, the".
197		ln 22	Insert comma after 'used'.
198		ln 25	Insert "to" after 'and'.
199	p 118	ln 5	Change "cylinders" to "cylinder".
200		ln 16	Change "bearings" to "bearing shell", delete "- if the sudden possible increase in crankshaft vibration is acceptable -".
201		ln 18	Insert comma after 'throws'.
202		ln 20	Insert comma after 'provided'.
203		ln 21	Replace comma with "and", insert period after '209' (now 44), replace "where a" with "A".
204		ln 22	Insert comma after '1131'.
205		ln 25	Insert comma after 'spring'.
206		ln 26	Insert comma after 'motion'.
207		ln 23	Insert comma after 'profile'.
208	p 119	ln 7	Change comma to period, delete "wherein".
209		ln 9	Add "(shown in Figure 47)" after link, delete "at b and c".
210		ln 11	Change ", add "1139" after 'spring', change "1139" to "1139a".
211		ln 12	Change "exaggeratedly" to "schematically" and "Two" to "Five".
212		ln 13	After 'here' change comma to colon, delete "and the spring/reservoir at 1139", substitute : "of component 1136, the spring 1139, the reservoir 1139a, the device at (a), the mat at 1143".
213		ln 15	Change "roller" to "rollers", delete "low extension", insert period after '1142', delete "in association with", capitalize 'A'.
214		ln 16	Insert "is shown at" after 'mat', comma after '1143'.
215		ln 19	Insert comma after 'end'.
216		ln 20	Insert "1139a" before 'is'.
217	p 120	ln 1	Change "delivery" to "fluid return".
218		ln 2	Insert comma after '1155'.
219		ln 7	Insert comma after '1168'.

220		ln 11	Add sentence after 'end.' : "The rod tip has passages for gas 1168".
221		ln 13	Insert "For example," before 'Figure 217' (now 52), delete "for example" after, insert comma after '1170'.
222		ln 25	Insert period after '1184', delete "and", substitute "The piston".
223	p 121	ln 7	Insert comma after '218' (now 53).
224		ln 10	Insert comma after 'head'.
225		ln 11	Insert comma after 'assemblies'.
226		ln 12	Insert comma after '1192'.
227		ln 13	Insert "and" before 'which'.
228		ln 14	Insert comma after '1197'.
229		ln 15	Delete brackets, insert comma after '225' (now 60), change "this" to "crank link 1193a"..
230		ln 17	move comma to after 'and'.
231		ln 19	Insert comma after 'alternatively'.
232		ln 20	Insert comma after 'earlier'.
233		ln 22	Delete : "(See Note 2)".
234		ln 24	Delete : "On reflection it is clear that", capitalize 1st 'The'.
235		ln 27	Insert comma after 'valves'.
236	p 122	ln 1	Delete : "In Figures 226(a) to 232, 226(a)", substitute "Figure 226(a)" (now 61).
237		ln 2	Insert "Figure" before '226(b)' (now 62).
238		ln 3	Delete : "Figures 226(a) and (b)", substitute "The figures".
239		ln 6	Delete "current', substitute "a", delete "twin bridges", substitute : "a collar with twin projections".
240		ln 7	Insert "a" after 'to', "(not shown)" after 'cam'.
241		ln 8	Insert comma after 'arrangement'.
242		ln 9	Delete "x" and "y", substitute "y" and "z" respectively, insert: ", measured from cylinder axis, " before 'to more'.
243		ln 11	Change "charge/exhaust" to "charge or exhaust", insert comma after '1212'.
244		ln 12	Delete "to that", substitute : "from another volume".
245		ln 13	Insert "such components as" after 'of', insert comma after 'members'.

246		ln 20	Change "fuel" to "fluid".
247		ln 22	Delete section starting with : 'However, in . . ." and ending with ". . . pre-combustion chamber." on ln 13 p 123.
248	p 123	ln 14	Start new para at 'Figure 232" (now 65), insert "having a central ring valve," after 'head'.
249		ln 15	Insert "fuel" after 'which'.
250		ln 17	Insert commas after 'show' and 'section'.
251		ln 18	Delete comma after "1231)'.
252		ln 24	Delete section starting from : "Figure 235 shows . . ." and ending with ". . . may be provided." on ln 11 p 124.
253	p 124	ln 12	Insert commas after 'show' and 'respectively', delete "the", insert hyphen after 'longitudinal'.
254		ln 13	Insert quotation marks around 'cup', change "integral cylinder/head" to : "assembly, each "cup" having an integral half-cylinder and head", change comma to period after 'configuration'.
255		ln 14	Delete "having", capitalize 'A', insert " is" after '1245', insert ", when the piston is at TDC' after '238' (now 70).
256		ln 15	Change "1258" to "1252", insert "1245" after 'space'.
257		ln 18	Insert "a" after 'into'.
258		ln 19	Insert after 'space.': "(It is obvious that the fuel at the wick 1246 can be used to provide some degree of lubrication between the rod portion of piston 1243 and "cup" 1244.)", insert "1244" after 'halves', change "piston" to "cylinder".
259		ln 20	Insert comma after '1249', change "re" to "are".
260		ln 21	Insert "at 1244a" after 'shown'.
261		ln 26	Change "1252" to "1253".
262		ln 27	Start new para at "In engine . . ."
263		ln 28	Insert "1254" after 'grooves', insert after '239': ", where the piston 1243 is travelling in the direction of arrow during compression".
264	p 125	ln 1	Change "1254" to "1255".
265		ln 3	Insert comma after 'that'.
266		ln 4	Delete "that".
267		ln 22	Start new para at "Figures 246 . . ." (now 72).
268	p 126	ln 7	Insert "a' after 'is'.
269		ln 8	Insert comma after '1293'.

270		ln 10	Insert comma after '1294)'.
271		ln 13	Insert comma after '1298'.
272		ln 14	Insert "changes" after 1282'.
273		ln 16	Insert comma after 'turn'.
274		ln 21	Insert sentence : "It is clear that differing interior profiles of the mid section of shell 1283 will cause varying travel speeds of inner shell 1284 between end positions, and so rates of acceleration and deceleration can be governed by varying shell profiles."
275		ln 25	Change "245" to "246" (now 72).
276	p 127	ln 1	Delete from "If it is . . ." to end of para at ". . . contact is made."on ln 8.
277		ln 16	Insert "reciprocating" before 'IC', change "an" to "a".
278		ln 19	Insert comma after '1317'.
279		ln 23	Insert commas after '1321' and '1322'.
280		ln 25	Insert comma after '1324' and "and" after 'temperature'.
281		ln 27	Change period to comma after 'etc' and insert "and" thereafter.
282	p 128	ln 1	Insert sentence after '1326.' : "Figure 78 is a long section and Figure 79 a cross-section through the cylinder, while Figure 80 shows one valve 1326.", insert comma after '1327'.
283		ln 3	Change "1330" to "1327".
284		ln 4	Insert sentence after '1332.' : "A similar construction, including tensile fasteners 1327, is shown also in Figures 68 and 69.", insert comma after 'stroke'.
285		ln 5	Insert "1326" after 'valves'.
286		ln 6	Insert "via the central port 1324,"
287		ln 8	Delete "See also Figures 236 and 237."
288		ln 9	Delete "It can be seen from Notes 5 and 7 that" and capitalize 'Combustion", insert comma after 'loads'.
289		ln 10	Insert comma after 'loads'.
290		ln 12	Delete "(say less than 500 rpm)".
291		ln 15	Delete sentences from "Figures 264 . . ." to ". . . at bearing face." on ln 18.
292		ln 19	Change "Note 8 describes" to "Regarding".
293		ln 20	Change period to comma, lower case 'it'.
294		ln 24	Delete sentence from "At present . . ." to ". . . applications)." on ln 27, substitute : "Calculations have shown that there are presently a range of commercially available

			ceramic materials having sufficient strength to be used to build the components of the invention, allowing for typical engineering safety margins."
295	p 129	ln 1	Insert "alternative" after 'of'.
296		ln 3	Change 'Then" to "In another example".
297		ln 4	Delete from "(eg Figures 216 . . ." to ". . . tensile load." on ln 5.
298		ln 6	Change "tension" to "tensioning".
299		ln 8	Delete from "Generally CAICE units . . ." to end of ln 7 on p 131 : ". . . are to scale."
300	p 131	ln 10	Delete sentence from "Water or . . ." to ". . . and 265." on ln 11.
301		ln 14	Delete section, from "4. Efficiency and . . ." to ". . . 5. Applications" on ln 16 p 134.
302	p 135	ln 1	Insert comma after 'designs', change "dimension" to "dimensional" and "variation" to "variations".
303		ln 4	Insert "the" after 'up', insert comma after 'speed'.
304		ln 5	Delete "i.e.," and substitute : "and therefore the".
305		ln 9	Delete new para, delete sentence from "If high . . ." to ". . . large ones."
306		ln 13	Delete section, from "The application . . ." to ". . . is established." on ln 19 p 136.
307	p 136	ln 26	Change "assigning" to "increasing" and "in" to "throughout".
308	p 137	ln 1	Insert after 'engines,' : "which are often force aspirated,".
309		ln 6	Delete "(or the fixed adjustment of inlet opening)".
310		ln 8	Delete section, from "This technique . . ." to ". . . are not used." on ln 15.
311		ln 16	Changed "established" to "has shown by way of example".
312		ln 19	Delete para, from "The cost . . ." to ". . . substantial." on ln 26.
313	p 138	ln 1	Change "CAICE units" to "engines".
314		ln 3	Delete "heavy", change "with which they are surrounded" to "that can be provided".
315		ln 5	Change "system, is now" to "system - can now be".
316		ln 6	Move comma from before to after 'and'.
317		ln 7	Change "situations" to "locations".
318		ln 9	Delete large section, from "An Improved Transmission . . ." to ". . . lines b, c, d, e, respectively." on ln 2 p 168.
319	p 168	ln 3	Insert : "As shown elsewhere, crankshafts may also function as camshafts." Delete from "It is apparent . . ." to ". . . or dual function," on ln 5, capitalize 'Lateral'.

320		ln 7	Change "86" to "5086" and "87" to "5087".
321		ln 8	Change "88" to "5088".
322		ln 10	Insert comma after 'performance'.
323		ln 12	Insert comma after 'yoke'.
324		ln 13	Change "89" to "5089".
325		ln 14	Change "90" to "5090" and "91" to "5087".
326		ln 15	Change "92" to "5092" and "93" to "5093".
327		ln 16	Change "94" to "5094", "95" to "5095" and "96" to "5096".
328		ln 17	Change "97" to "5097" and "98" to "5098".
329		ln 18	Change "94" to "5094".
330		ln 19	Change "99" to "5099".
331		ln 21	Change "in other sections" to "elsewhere".
332	p 169	ln 1	Change "100" to "5100" and "101" to "5101".
333		ln 2	Change "102" to "5102" and "103" to "5103", insert comma after '5102', change comma after '5103' to period, capitalize 'The', change "being" to "are".
334		ln 3	Change "104" to "5104" and "105" to "5105".
335		ln 4	Change "106" to "5106" and "107" to "5107".
336		ln 5	Change "108" to "5108".
337		ln 11	Change "109" to "5109" and "111" to "5111".
338		ln 12	Change "110" to "5110".
339		ln 13	Change "114" to "5114", "115" to "5115" and "116" to "5116".
340		ln 14	Change "117" to "5117".
341		ln 15	Change "118" to "5118".
342		ln 16	Change "119" to "5119".
343		ln 17	Change "120" to "5120".
344		ln 23	Delete para, from "It has been . . ." to ". . . than halved." on ln 11 p 170.
345	p 170	ln 12	Change "the specification" to "this disclosure".
346		ln 14	Delete most of sentence, from "the improved . . ." to ". . . exhaust valves." on ln 18.

347		ln 18	Change "In" to "in", insert comma after 'principles'.
348		ln 23	Delete heading "Simplification"
349		ln 24	Change "in the preceding sections" to "above".
350		ln 26	Delete sentence from "For . . ." to. . . "headings."
351	p 171	ln 1	Delete "1. Torroid"
352		ln 2	Insert comma after 'show'.
353		ln 3	Insert comma after 'example'.
354		ln 9	Delete "In other words,", capitalize 'The'.
355		ln 13	Change "2" to "1".
356		ln 18	Change "later" to "elsewhere".
357		ln 19	Insert after 'ratio.' : "In some expressions herein, compression ratio is abbreviated as CR."
358		ln 19	Insert old Table 2 (now renumbered Table 1) below.
359		ln 20	Delete "2. Porting".
360	p 172	ln 2	Change "as" to "is".
361		ln 3	Insert comma after 'hollow'.
363		ln 4	Delete comma after '2009', insert "with" before 'the', insert comma after 'and' and "via" before 'exposed'.
363		ln 5	Insert comma after '2010'.
364		ln 6	Insert period after 'chamber', delete "and in fact", capitalize 'The' on next line.
365		ln 8	Change comma after 356 to "and", insert comma after '357' (now 93).
366		ln 11	Change "at" to "from".
367		ln 12	Insert "of" after 'ends', insert commas before 'and' and after 'by'.
368		ln 14	Delete "inner".
369		ln 19	Change "these kind of" to "The".
370		ln 22	Insert comma after 'expansion'.
371		ln 23	Change "have" to "has".
372		ln 28	Change "b/cr" to "(b - cr)".
373	p 173	ln 1	Change "b/cr" to "(b - cr)".

374		ln 2	Delete sentence from "In other . . ." to ". . . dimensions." on ln 4.
375	p 174	ln 1	Delete heading "3. Crankshaft".
376		ln 2	Change "in other sections" to "herein".
377		ln 6	Change "eliminated" to "changed to fixed length links,".
378		ln 8	Insert after 'links.' : "Obviously, the greater the link length in relation to crank throw, the closer to synchronous the cranks' motion will be."
379		ln 25	Insert "is" after 'turn', insert after 'mounted' : "in a slotted carrier strut 3035a, which is mounted".
380		ln 26	Insert comma after '2026'.
381		ln 27	Insert after 'mounted' : "(so ensuring that the roller assembly can also move in direction 2029)"
382	p 175	ln 1	Delete section, from "Alternatively, if . . ." to ". . . 4. Cams" on ln 13 p 176.
383	p 176	ln 16	Change "becomes the crankshaft" to "could become the "crankshaft" (actually, the drive shaft)".
384		ln 24	Insert after 'applications.' : "(The new engines will reciprocate much faster than the units they could replace, but installed transmissions, propellers, etc are suited to today's lower speeds. The conversion of fast reciprocation to slow rotation implies the new engines could easily be fitted in existing applications.)"
385	p 177	ln 14	Insert comma after 'earlier', change comma to period, capitalize 'In', insert "an" after 'of'.
386		ln 15	Insert comma after 'system', change "simultaneously in rotating and reciprocating motion" to : "one component will simultaneously rotate and reciprocate in relation to the other".
387	p 178	ln 3	Change 1st comma to "and", insert comma after '359' (now 95).
388		ln 7	Insert comma after '365' (now 99).
389		ln 11	Insert after '2055' : "(shown in Figure 98)".
390	p 179	ln 7	Insert "the" after 'across' and "at" after 'bridge'.
391		ln 8	Insert comma after 'example'.
392		ln 9	Insert comma after '2071'.
393		ln 14	Insert after 'expansion.' : "Such combustion chambers are described more fully later."
394		ln 16	Delete: "and if the ports are not continuous,".
395		ln 18	Delete section, from "On the other . . ." to ". . . electrical system." on ln 2 p 180.
396	p 180	ln 7	Delete new para after 'mechanism.'
397		ln 11	Delete heading "5. Drive".

398		ln 14	Delete from ", or to use . . ." to ". . . earlier." on ln 16.
399		ln 16	Delete new para after 'earlier.'
400		ln 19	Change "crankshaft" to : "piston/rod assembly (effectively the "crankshaft", actually the drive shaft)".
401		ln 21	Insert comma after 'ball'.
402		ln 23	Insert comma after '2079'.
403		ln 24	Insert period after '2080', delete "when", capitalize 'Roller'.
404	p 181	ln 9	Change "and" to "or", insert comma after 'type'.
405		ln 13	Delete "and".
406		ln 14	Change "travel" to "travels".
407		ln 21	Delete sentence, from "In the case . . ." to ". . . dead center." on ln 25.
408		ln 25	Delete "in fact", capitalize 'The'.
409	p 182	ln 9	Delete section , from "6. Fuel . . ." to ". . . in Figures 385, 386." on ln 11 p 186. Note:
410	p 186	ln 12	Delete "2. Sinusoidal Actuation"
411		ln 13	Insert "in" before 'Figure', change "very" to "and".
412		ln 14	Insert comma after 'chambers'.
413		ln 15	Insert comma after 'configuration'.
414		ln 19	Insert comma after 'other'.
415		ln 21	Insert comma after 'engines)', delete "circular".
416		ln 25	Insert comma after '3007', insert "3004" after 'element'.
417	p 187	ln 3	Insert "two" before 'surfaces', change "most extreme" to "the maximum possible", insert comma after '3038'.
418		ln 8	Change "similar" to "similarly".
419		ln 10	Insert "curved" after 'partial'.
420		ln 12	Change "ration" to "ratio".
421		ln 18	Change "Therefore" to "Usually", insert comma after 1st 'chamber".
422		ln 19	Insert "surface of that" after 'lower'.
423		ln 20	Change "in every case" to "often"
424		ln 21	Insert comma after 'ratio', delete brackets, change "don't" to "do not".

425		ln 25	Insert comma after 'case'.
426	p 188	ln 1	Delete "in an", insert comma after 'earlier'.
427		ln 2	Delete "section".
428		ln 9	Insert comma after 'conventional)'.
429	p 189	ln 7	Insert comma after '396' (now 115).
430		ln 13	Delete new para at "The curves . . ."
431	p 190	ln 10	Insert period after 'reasons', delete "and", capitalize 'Because'.
432		ln 11	Change "corresponding" to "can correspond".
433		ln 19	Insert before 'each' : "here located on the reciprocating component,"and delete "here" after 'each'.
434		ln 22	Change "4048" to "3048".
435		ln 26	Insert "otherwise" after 'for'.
436		ln 27	Insert "parameters" after 'combustion'.
437	p 191	ln 1	Delete "of course," and capitalize 'Any'.
438		ln 11	Insert after 'chamber.' : "(In these schematic illustrations, the actual fuel delivery mechanism is not shown.)"
439		ln 15	Delete "In the disclosure," and capitalize 'The', change "is" to "has been".
440		ln 16	Delete "in the disclosure".
441		ln 21	Insert "(as shown schematically at 3058a)" after 'system'.
442		ln 25	Delete "so".
443	p 192	ln 3	Insert "and" after 'surfaces', change comma to "and", change "are" to "can be used as".
444		ln 4	Change comma to period, change "the" to "Such an" and "being" to "is", insert commas after 'suitable' and 'example'.
445		ln 9	Insert comma after 'arrangement'.
446		ln 11	Insert after 'schematically' : ", where the apparatus is shown only on one side of a center line".
447		ln 14	Insert after 'systems : "(not shown)".
448		ln 17	Insert comma after 'guides'.
449		ln 25	Insert "Here," before lower case 'component'.
450		ln 26	Insert after 'Figure 399,' (now 118) : "similarly to Figure 117."

451		ln 27	Change "wherein are" to "There".
452	p 193	ln 2	Insert comma after '3075'.
453		ln 3	Insert comma after '3074'.
454		ln 10	Change "drives" to "could drive", insert comma after '3078'.
455		ln 12	Change comma to "and", delete "most".
456		ln 19	Insert comma after 'example'.
457		ln 23	Delete new para at "In engines . . ."
458	p 194	ln 2	Start new para at "The", which is changed to "A".
459		ln 8	Insert "at" before '3082'.
460		ln 12	Change "intersecting" to "to intersect".
461		ln 19	Insert "3007" after 'housing', delete "(not shown)".
462		ln 20	Delete "(not shown)".
463	p 195	ln 1	Insert comma after 'conditions'.
464		ln 5	Insert "3087" after 'bearings'.
465		ln 25	Delete new para at 'The most . . ."
466	p 196	ln 3	Change "such as 3004" to "(such as piston/rod assembly 3004)".
467		ln 19	Insert commas after 'of' and 'by'.
468		ln 25	Insert after '3112' : "arranged circumferentially,".
469	p 197	ln 1	Insert "and 3111a" after '3110a'.
470		ln 7	Insert comma after 'assembled'.
471		ln 10	Insert "combustion" after 'twin' and "3115" after 'chamber'.
472	p 198	ln 4	Change "3122" to "3122a".
473		ln 16	Delete heading "3. Modular Construction".
474		ln 19	Change comma to "and".
474a	p 199	ln 7	Insert "Filamentary material is shown at 3128a." after '. . .exhaust.'
475		ln 9	Insert comma after 'ports'.
476		ln 21	Change "compressor/turbine" to "compressor and / or turbine".
477	p 200	ln 23	Insert comma after 'possible'.

478	p 201	ln 7	Insert "A and B" after 'sections', "approximate" after "in".
479		ln 21	Change "charge" to "those containing charge air", insert comma before 'this'.
480		ln 25	Insert comma after 'embodiments'.
481		ln 26	Delete "electric motor/generator,".
482		ln 28	Change 'will be" to "is".
483		ln 29	Change "later" to "elsewhere".
484	p 202	ln 2	Insert "from them" after 'separated'.
485		ln 3	Change "cold" to "could".
486	p 203	ln 3	Delete sentence, from "The approximate . . ." to ". . . being regular." on ln 6.
487		ln 22	Insert "similar" after 'and'.
488		ln 24	Change "part' to "port", insert ", thereafter leaving the combustion chambers via exhaust port 3174 into essentially tubular exhaust processing volume 3175" after '3185'.
489	p 204	ln 8	Change "tho" to "to".
490		ln 12	Change 1st comma to "and".
491		ln 16	Insert comma after 'corners'.
492	p 205	ln 3	Change "application" to "applications".
493		ln 18	Change 1st comma to "and".
494		ln 21	Delete "electric motor/generator component,".
495	p 206	ln 6	Delete "Of course," and capitalize 'In'.
496		ln 8	Insert (not shown) after 'rotation'.
497		ln 17	Change "compulsion" to "combustion".
498	p 208	ln 3	Change comma to "or", delete : "(or a slot-drive crankshaft as shown in Figures 381 to 386, for example)".
499		ln 8	Change "the" to "or a", change 2nd comma to period, delete "with", capitalize 'Separate'.
500		ln 9	Insert "can be" after 'systems'.
501		ln 13	Delete : "slot-drive" and from ", such as in Figures 381 through 386 . . ." to " . . . a scotch yoke."
502		ln 18	Change ", conventional or slot-drive" to "or".
503		ln 21	Delete : ", as shown for example in Figure 389".

504		ln 25	Insert comma after 'reciprocates'.
505	p 209	ln 3	Delete "The slot-drive", capitalize "Crankshafts".
506		ln 4	Delete from "(for example . . ." to ". . . to 407) on ln 5.
507		ln 8	Change first comma to period, delete section from " as shown . . ." to ". . . crank 3141." on ln 12.
508		ln 22	Change "above" to "herein.", delete section from "- conventional . . ." to ". . . devices, including the following:" on ln 3 p 210 and substitute : "They could include".
509	p 210	ln 7	Delete section from "In Figure 397 . . ." to ". . . relative to 3056." on ln 11.
510		ln 13	Insert "3153" after 'motor'. Delete large section, from : "3153 shows . . ." to the end of the handwritten addition to p 226". . . the deployed parachute fouling the rotor blades."

[Continue the amendments now from the original page 1, part of the material that was moved to the end of the text.]

511	p 1	ln 1	Delete section, from "An Improved Means . . ." to ". . . of the invention" on p 2 ln 13.
512	p 2	ln 19	Delete large section, from "The provision of. . ." to end of heading ". . . Preferred Embodiments." on p 15 ln 18. Continue paragraph p 2 ln 19 as follows: "An internal combustion engine generates great heat which is substantially contained in the exhaust gases leaving the combustion chamber. The best way to use this heat to clean the exhaust gases is to either place the exhaust gas treatment volume in the engine or as close to it as possible."
513	p 15	ln 18	Insert the following para: "So far in this disclosure, exhaust gas processing volumes of various forms have been shown inside an engine or engine casing. Included are the cylindrical volumes B in Figure 129 and volume C in Figure 132 - form summarized in Figure 146, the tubular volumes B in Figures 130 and 132 as well as volumes 1008 in Figure 20 and 1290 in Figure 21 - form summarized in Figure 147, and the semi-rectangular volumes similar to 1310 in Figure 75 - base form summarized in Figure 148. These semi-rectangular forms are usually associated with an engine with a rectangular casing or housing, which defines part of the exhaust processing volume. In some applications, the exhaust gas processing volumes, also known as reactors, can be outside the engine or engine casing, in much the same manner as exhaust manifolds are presently attached to engine blocks or cylinder heads. In the disclosure of exhaust gas treatments that follows, many examples illustrated will show externally applied reactors, but the features and principles disclosed may also be applied to reactors or volumes within an engine."
514		ln 19	Change "In carrying the invention into effect as" to "An embodiment is".
515		ln 20	Insert "where" before 'the'.
516		ln 24	Delete "14".
517		ln 26	Delete 1st "block" ', change "ports" to "openings", change "block" to " engine".
518	p 16	ln 4	Change "port" to "opening", insert comma after '17', change "at the port outlet" to "beyond the opening".
519		ln 5	Delete sentence ending "in this section" on ln 6.

520		ln 7	Change "on" to "in relation to".
521		ln 10	Delete "oxidize and".
522		ln 18	Change comma to period, capitalize "The".
523	p 17	ln 2	Insert comma after '20'.
524		ln 6	Delete from "It will . . ." to ". . . position of", capitalize 2nd 'The".
525		ln 12	Delete from "are encouraged . . ." to ". . . reduction." on ln 13, and substitute : "react more completely."
526		ln 14	Delete "a high performance" and substitute "an".
527		ln 16	Insert comma after 'embodiment'.
528		ln 18	Delete from "port 17 . . .' to ". . . cooling systems. " on ln 19 and substitute : "exhaust processing volume opening(s) 17.
529		ln 20	Insert "an" after 'comprising'.
530		ln 21	Insert comma after 'shell'.
531		ln 23	Change "block" to "engine", delete "and cooling system".
532		ln 24	Change "port" to "opening".
533		ln 25	Change "block" to "engine".
534	p 18	ln 6	Delete "metal".
535		ln 12	Move "described above" to after 'films, changed "describes" to "shows".
536		ln 25	Insert comma after ' alternatively'.
537	p 19	ln 2	Delete "or 'plastics' ", insert "or" after 'material,' delete from "ie materials . . ." to ". . . generic materials as" on ln 4.
538		ln 4	Delete sentence from "These . . ." to "hereinafter." on ln 5.
539		ln 16	Delete from ", including . . ." to ". . . above" on ln 17.
540		ln 23	Delete section, from "It will be appreciated that . . ." to ". . . desirable." on p 20 ln 5.
541	p 20	ln 17	Delete section, from "The principles . . ." to ". . . engine configurations." on ln 25.
542		27	Change "ports" to "openings".
543	p 21	ln 2	Delete section, from "Conventional thermal . . ." to ". . . cooling system." on ln 13.
544		ln 13	Delete "Because of", capitalize "The",, change "invention" to "housing".
545		ln 17	Insert comma after 'heat'.

546		ln 18	Insert comma after 'manner'.
547		ln 21	Insert "generally" after 'this'.
548		ln 23	Change "port" to "opening".
549		ln 29	Insert sentence after 'housing.' : "Most of the benefits described above will be greater, if the reactor is all or part of an exhaust processing volume contained within an engine."
550	p 22	ln 3	Change ", in effect, means exposing" to "exposes".
551		ln 9	Change "reacted" to "reacting".
552		ln 18	Change "spark plug and fuel entry" to : "fuel entry and of any spark plug".
553		ln 23	Insert "currently" before 'used'.
554		ln 26	Delete section, from "Conventional . . ." to ". . . of the gas." on ln 29.
555	p 23	ln 1	Delete "It is intended that the invention incorporates", capitalize "Catalytic".
556		ln 2	Insert "are" after 'strength' and "can be used" after 'desired'.
557	p 24	ln 6	Delete ", such as for example lead compounds".
558		ln 10	Delete "notoriously".
559		ln 14	Delete section, from "As with . . ." to ". . . the assembly." on ln 23.
560		ln 27	Insert after 'device.' : "A broad description of the chemical processes can be found in my US patent 5 031 401." Delete large section, from "The three main . . ." to ". . . pollutant, NOx." on p 27 ln 7.
561	p 27	ln 14	Change "the present invention" to "this disclosure".
562	p 28	ln 1	Change "in later sections" to "later".
563		ln 12	Insert "roughly" after 'of'.
564	p 29	ln 6	Insert after 'reactor' : ", an important advantage when having to comply with cold-start emission regulations."
565		ln 7	Delete section, from "This feature . . ." to ". . . thermal reactors, but" on ln 10, capitalize 'The'.
566		ln 14	Insert comma after 'temperature'.
567		ln 15	Insert comma after 'closed'.
568		ln 21	Insert comma after 'use'.
569		ln 22	Change "the vehicle" to " an engine" and "drivable" to "usable".
570		ln 24	Change "clutch" to "engine".

571	p 30	ln 5	Change "hereinafter" to "later".
572		ln 13	Insert comma after 'embodiment'.
573		ln 16	Delete : ", and the clutch may be engaged".
574		ln 18	Delete large section, from "The invention can . . ." to ". . . is described subsequently." on p 32 ln 7.
575	p 32	ln 9	Change "as has been noted, the" to "A".
576		ln 10	Delete "or cylinder block".
577		ln 11	Delete "In effect," and capitalize 'The'.
578		ln 14	Change "block" to "engine".
579		ln 16	Change "block" to "engine".
580		ln 19	Change "block" to "engine".
581		ln 21	Change "block" to "engine".
582	p 33	ln 8	Change "ports" to "openings".
583		ln 12	Insert "or opening" after 'cylinder'.
584		ln 23	Change "exit with its" to "opening having a".
585		ln 24	Insert comma after 'shape'.
586		ln 26	Change "port and block" to " opening and engine face,".
587		ln 28	Change "port" to "opening".
588	p 34	ln 4	Delete "block".
589		ln 5	Change "port" to "opening", insert comma after '54' (now 154).
590		ln 7	Delete "block".
591		ln 9	Insert comma after '6' (now 154).
592		ln 10	Delete "block".
593		ln 12	Insert comma after '6' (now 154).
594		ln 22	Change "port" to "opening".
595		ln 24	Delete "block".
596		ln 26	Insert comma after 'components'.
597	p 35	ln 1	Change "port" to "opening".

598		ln 2	Insert comma after '10' (now 158).
599		ln 3	Delete "block".
600		ln 10	Change "block" to "casing".
601		ln 15	Delete "metal" and "block, and its associated cooling system".
602		ln 20	Change "7" to "155".
603		ln 25	Insert "assembly" before 1st 'of', change "10" to "158".
604	p 36	ln 2	Change "ports" to "openings".
605		ln 3	Delete "block".
606		ln 6	Change "twinned inlet ports" to "other features".
607		ln 14	Delete "block".
608		ln 15	Delete sentence, from "If so, it . . ." to ". . . for cooling." on ln 19.
609		ln 19	Delete "block".
610		ln 23	Delete "block", change "ports" to "openings".
611		ln 24	Change "block" to "engine".
612		ln 28	Change "ports" to "openings".
613	p 37	ln 3	Change "port" to "opening".
614		ln 4	Change "port" to "opening".
615		ln 5	Change "this" to "a", insert comma after 'embodiment', change "port" to "opening".
616		ln 6	Change "port" to "opening".
617		ln 10	Change "in the previous section" to "above".
618		ln 11	Change "port" to "opening".
619		ln 14	Change "port" to "opening".
620		ln 17	Insert comma after 'alloy'.
621		ln 18	Change "port" to "opening".
622		ln 21	Change "and acceleration of" to "the".
623		ln 23	Change "port" to "opening".
624		ln 27	Change "port" to "opening".
625	p 38	ln 2	Delete "block".

626		ln 3	Change "port" to "opening".
627		ln 5	Insert "84a" after 'face', change "port" to "opening".
628		ln 14	Change "port" to "opening".
629		ln 15	Delete comma.
630		ln 17	Insert comma after '88'.
631		ln 20	Change "port" to "opening".
632		ln 21	Change "block" to "engine".
633		ln 24	Change "ports" to "openings".
634		ln 25	Change "ports" to "openings".
635		ln 28	Change "port" to "opening".
636	p 39	ln 2	Change "port" to "opening".
637		ln 5	Insert comma after '27' (now 175).
638		ln 9	Change "port" to "opening", delete "block".
639		ln 15	Insert comma after 'configuration'.
640		ln 16	Insert comma after '97'.
641		ln 20	Change "groves" to "grooves".
642		ln 21	Delete sentence, from "Throughout . . ." to ". . . motor usage." on ln 23.
643	p 40	ln 1	Delete heading and sentence, from "Filamentary . . ." to ". . . subsequently." on ln 3.
644		ln 4	Change "was' to "is".
645		ln 12	Delete "and are".
646		ln 14	Change "ports" to "openings", insert comma thereafter.
647		ln 19	Delete "It has been noted that", capitalize "The".
648		ln 25	Change "ports" to "openings".
649		ln 26	Delete ", therefore,".
650	p 41	ln 1	Delete new para, delete "It is intended that", capitalize 'The'.
651		ln 15	Insert commas after '103a' and 'arrows'.
652		ln 16	Insert comma after 'and'.
653		ln 17	Insert comma after 'assembly', delete "In other words," capitalize 'Although'.

654		ln 23	Delete "plan".
655	p 42	ln 8	Insert comma after 'advantageous', delete "in the invention".
656		ln 13	Delete "That is," and capitalize 'It'.
657	p 43	ln 8	Insert comma after 'housing'.
658	p 44	ln 19	Insert comma after 'parallel', insert "they could be" after 'that is'.
658a	p 45	ln 4	Delete "in this section".
659		ln 19	Insert comma after '60' (now 208).
660	p 46	ln 4	Delete "Considering Figures 66 and 67", capitalize 'Both', insert comma after '136'.
661		ln 5	Insert comma after 'supports'.
662		ln 12	Insert comma after 'ceramic'.
663		ln 15	Insert comma after '138'.
664		ln 19	Delete para, from "The filamentary . . ." to ". . . interconnected rods." on ln 24.
665	p 47	ln 16	Insert comma after '129a' (now 226).
666		ln 24	Insert commas after 'can' and 'example'.
667	p 48	ln 6	Delete heading and para, from "Cold Start . . ." to ". . . gas recirculation." on ln 12.
668		ln 13	Change "in section one" to "earlier".
669		ln 14	Insert comma after 'effective'.
670		ln 16	Change "case' to "cases".
671		ln 17	Insert comma after 'characteristics'.
672		ln 21	delete "therefore".
673	p 49	ln 14	Insert comma after 'invention'.
674		ln 16	Insert comma after 'gas'.
675		ln 17	change "With an over" to "Above", delete "incorporated" and "surmounted by a carburetor. A fan draws air through the radiator".
676		ln 20	Insert comma after '160'.
677		ln 23	Insert comma after '164'.
678		ln 25	Insert commas after '166' and '159'.
679		ln 28	Insert "as shown in the right half of Figure 230" after 'position'.

680	p 50	ln 8	Insert comma after 'partly'.
681		ln 16	Delete section, from "During the warm . . ." to ". . . screening period." on ln 22.
682	p 51	ln 10	Change "ports" to "openings".
683		ln 20	Delete "above or at the carburetor".
684		ln 23	Delete sentence, from "In a . . ." to ". . . carburetor." on ln 24.
685	p 52	ln 4	Change "It is here proposed to describe" to "Described here".
686		ln 5	Insert "are" before 'certain'.
687		ln 13	Delete section, from "Alternative butterfly . . ." to ". . . seen later." on ln 18.
688		ln 21	Change "181" to "180".
689		ln 22	Insert comma after 'having'.
690		ln 23	Insert comma after 'system', change "option" to "optional".
691		ln 27	Insert comma after 'configuration'.
692	p 53	ln 4	Insert comma after '191'.
693	p 54	ln 22	Change "was as" to "as is".
694	p 55	ln 5	Move "closely" to after 'to'.
695	p 56	ln 3	Insert comma after '231'.
696		ln 4	Change "asserts" to "assists".
697		ln 11	Move comma to after 'but'.
698		ln 12	Insert comma after 'conditions", insert "to" after 'and / or'.
699		ln 13	Delete "to".
700		ln 14	Start new para at "An optional . . ."
701		ln 15	Change "would, by way of example shown" to "could, as shown by way of example".
702		ln 16	Change "operative" to "dependent".
703		ln 19	Insert comma after '239'.
704		ln 22	Delete from "(caused by . . ." to ". . . inlet port)" on ln 24.
705	p 57	ln 4	Insert period after 'range', change 'causing' to "This can cause".
706		ln 19	Change 'carburetor' to "fuel supply".
707	p 58	ln 5	Delete from 'In' to 'disclosure.' on ln 7.

708		ln 7	New para at 'The above . . .'
709		ln 28	Insert comma after 'Alternatively'.
710	p 59	ln 6	Delete from 'Reaction Process' to 'engine' on ln 6 p 60, new para at 'Where . . .'
710a	p 60	ln 8	Insert comma after 3rd 'engine'.
711		ln 9	Delete large section, from "Concerning IC engine . . ." to ". . . are fully documented." on p 61 ln 18 .
712	p 61	ln 25	Delete sentence, from "The latter . . ." to ". . . petroleum." on ln 27.
713	p 62	ln 5	Delete from "Desirable . . ." to ". . . products." on ln 7.
714		ln 12	Delete new para, and section from "The introduction . . ." to ". . . with water." on ln 27.
715	p 63	ln 1	Delete section, from 'It is felt . . .' to '. . . future.' on ln 4.
716		ln 9	Delete "In the section which follows are described", substitute "Described below are".
717		ln 12	Delete from 'Additionally . . .' to '. . . elevationally.' on ln 2 p 64.
718	p 64	ln 3	Continue preceding para with "In the case . . ."
719		ln 4	Delete 'or port'.
720		ln 5	Delete from "or any . . ." to ". . . above".
721		ln 11	Insert comma after '274', change 'having to "which has."
722		ln 17	Change 'the outer 279,' to "an outer nozzle 279, both".
723		ln 21	Insert comma after '99a' (now 255).
724	p 65	ln 6	Delete 'inappropriately'.
725	p 66	ln 10	Delete from "Additionally, . . ." to "elsewhere." on ln 12.
726		ln 16	Insert comma after 'material', change 'it' to "them".
727		ln 19	Insert comma after 'and'.
728		ln 20	Insert comma after 'off'.
729		ln 21	Insert comma after 'heads'.
730	p 67	ln 6	Insert comma after 'and'.
731	p 68	ln 3	Insert comma after '167'.
732		ln 4	Insert comma after 'profile'.
733		ln 5	Insert comma after 'manner'.

734		ln 6	Insert comma after '166'.
735		ln 22	Change 'this' to "the movement of injectors".
736	p 69	ln 4	Insert comma after 'manner'.
737		ln 11	Insert "the" before 'injector'.
738		ln 13	Insert comma after 'head'.
739	p 70	ln 13	Move 'shows' to after '170'.
740		ln 14	Change 'rotational' to " rotation,".
741		ln 15	Insert "the" after 'issue,'.
742		ln 16	Insert "in" after 'detail', insert commas after 'having' and 'axis'.
743		ln 18	Insert comma after 'shows'.
744		ln 19	Insert comma and "a" after 'period'.
745		ln 22	Insert "located" after '821'.
746		ln 27	Insert comma after 'engine'.
747	p 71	ln 1	Insert comma after '821'.
748		ln 3	Insert comma after 'stroke'.
749		ln 13	Insert comma after 'construction'.
750		ln 14	Insert comma after 'illustration'.
751	p 72	ln 9	Insert comma after '850'.
752		ln 13	Insert comma after 'arrangement'.
753	p 73	ln 13	Delete heading and para from 'Form of . . .' to '. . . engine.' on ln 19.
754		ln 24	Delete 'block'.
755	p 74	ln 2	Change 'fully' to "properly".
756	p 75	ln 4	Delete large section, from 'The reactor . . .' to '. . . by dam 363.' on ln 17 p 79.
757	p 79	ln 18	Delete 'in this and previous sections' and substitute "herein".
758		ln 20	Delete sentence 'It is . . .' to '. . . charge' on ln 22.
759		ln 25	Insert comma after 'invention'.
760		ln 26	Insert comma after 'eliminated'.
761	p 80	ln 1	Delete "atomization of fuel,".

762		ln 2	Delete "fuel ".
763		ln 3	Change "reaction" to "reactor", delete 'in Section Four' and substitute "earlier".
764		ln 4	Delete "cylinder head/" and "block".
765		ln 8	Change both 'port's to "opening", insert "to" before 'and'.
766		ln 18	Insert comma after 'engines'.
767		ln 20	Combine this with previous para, delete section from "A principle . . .' to '. . . charge flow.' on ln 3 p 81.
768	p 81	ln 3	Delete "considerable".
769		ln 4	Change "The above" to "This" and make new para.
770		ln 6	Delete long section, from "By way of . . ." to ". . . housing." on ln 24 p 82.
771	p 82	ln 27	Delete from ", especially . . ." to ". . . 147." on ln 28.
772	p 83	ln 2	Insert comma after 'members'.
773		ln 3	Delete sentence from "This . . ." to ". . . conditions." on ln 5.
774		ln 16	Delete long section, from "It is known . . ." to heading ". . . Methods" on ln 5 p 87.
774a	p 87	ln 6	Delete "firstly".
775		ln 9	Delete section, from "Lastly . . ." to ". . . methods." on ln 15.
776		ln 15	Delete "Of course", capitalize "The".
777		ln 18	Delete para, from "The more . . ." to ". . . between." on ln 15 p 88.
778	p 88	ln 17	Insert comma after 'cobalt'.
779	p 89	ln 4	Delete section, from "Because of . . ." to ". . . invention, they" on ln 6 and substitute "Ceramic materials".
780		ln 7	Change "port" to "opening".
781		ln 16	Delete "In fact", capitalize 'It'.
782		ln 19	Delete "generally".
783	p 90	ln 6	Delete sentence from "The techniques . . ." to ". . . invention." on ln 10.
784		ln 21	Delete long section, from "Wool, especially . . ." to ". . . fluid." at end p 93.

END OF AMENDMENTS